

**Course Name :** Civil Engineering Group **Course Code :** CE/CS/CR/CV

**Semester :** Third

**Subject Title :** Concrete Technology **Subject Code:** 9021

**Teaching & Examination scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	Paper Hrs	TH	TEST	PR	OR	TW	TOTAL
04	--	02	03	80	20	--	50@	--	150

**Rationale:**

Concrete Technology is a core technology subject of the courses of civil engineering group. Concrete is most widely used construction material in all types of civil engineering structures. Concrete is extensively used in the construction of various kinds of buildings, pavements, bridges, dams, waterways, pipes, water tanks, swimming pools etc. Advances in concrete technology have paved the way to make use of locally available materials by judicious selection of materials, its mix proportioning & proper workmanship so as to result in concrete that satisfies the performance criteria of the structure as per design. i.e. strength, durability and resistance to environmental attack.

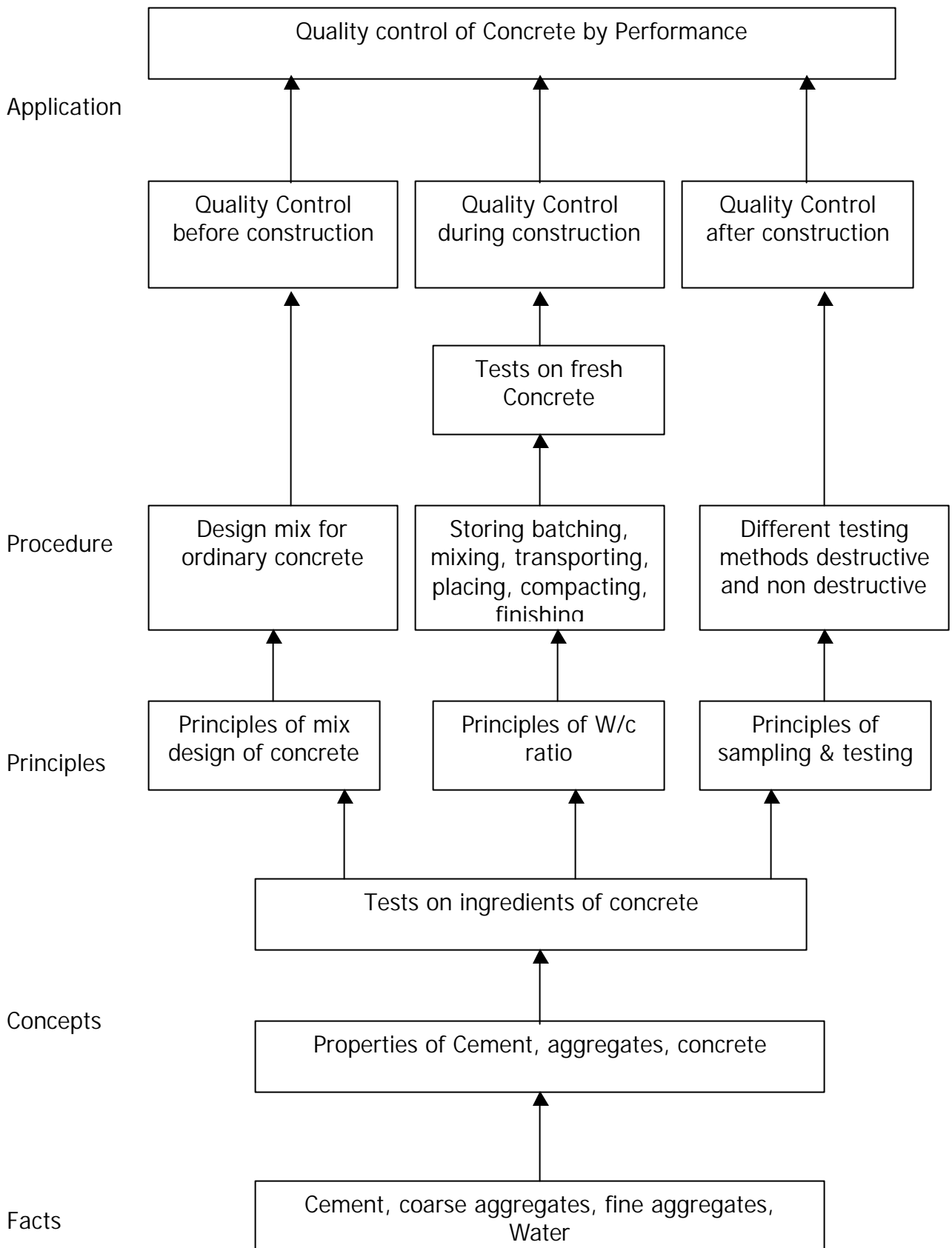
Civil engineering technician is to plan, execute the construction work as per drawing, supervise and ensure the quality of final product of concrete it means strength, durability & finish. For effective supervision & quality control of concrete construction at all stages of concrete chain which broadly consists of supply, storage of concrete ingredients, various concreting operations & testing operations before, during & after construction. For this purpose, a civil engineering technician must have good knowledge of the concrete materials ( i.e. properties of cement, sand, coarse aggregate water & admixtures.) and the main operations of concreting i.e. selection of materials, its mix proportioning, mixing, placing, compaction, curing & finishing. A technician should acquire the skill of testing, supervision of concrete work & interpretation of tests results.

## **Objectives:**

The Students will be able to

1. Determine the properties of concrete ingredients i.e. cement, sand, coarse aggregate by conducting different tests.
2. Use different types of cement as per their properties for different fields applications.
3. Design economic mix proportion for different exposure conditions and intended purposes.
4. Supervise various concreting operations.
5. Carry out field and laboratory tests on concrete in plastic and hardened stage.
6. Use different types of admixtures to improve the properties of concrete for different field applications.
7. Describe different types of concrete.
8. Infer the test results as per relevant I.S. provisions.

**Learning Structure:**



## Contents: Theory

Chapter	Name Of The Topic	Hours	Marks
01	<p><b>Properties of Cement:</b></p> <p>1.1 Physical properties of Ordinary Portland cement (OPC), determination and test on OPC, Hydration of cement, physical properties of cement – fineness, standard consistency, initial &amp; final setting times, compressive strength &amp; soundness, different grades of opc 33, 43 , 53 &amp; their specification of physical properties as per relevant I. S. codes. Adulteration of cement (field test), storing cement at site, effect of storage of cement on properties of cement / concrete.</p> <p>1.2 Types of Cement Physical properties, specifications as per relevant IS codes &amp; field application of the following types of cement</p> <ul style="list-style-type: none"> <li>i) Rapid hardening cement</li> <li>li) Low heat cement</li> <li>lii) Pozzolana Portland cement</li> <li>lv) Sulphate resisting cement</li> <li>Vi) Blast furnace slag cement</li> <li>Vii) White cement</li> </ul>	08	12
2.0	<p><b>Properties of Aggregates :</b></p> <p>2.1 Properties of fine aggregates : Concept of size, shape, surface texture, strength, specific gravity, bulk density , water absorption, surface moisture, soundness, bulking impurities</p> <p>2.2 Determination of fineness modulus &amp; grading zone of sand by sieve analysis, determination of silt content in sand &amp; their specification as per IS 383</p> <p>2.3 Bulking of sand, phenomenon of bulking, its effect on concrete mix proportion.</p> <p>2.4 Properties of coarse aggregates : Concept of size, shape, surface texture, water absorption, soundness, specific gravity &amp; bulk density</p> <p>2.5 Determination of fineness modulus of coarse aggregate by sieve analysis, grading of Coarse Aggregates</p> <p>2.6 Determination of crushing value, impact value &amp; abrasion value of coarse aggregate, flakiness index &amp; elongation index of coarse aggregate and their specification.</p>	12	16

03	<p><b>Properties of Concrete:</b></p> <p>3.1 Introduction to concrete - Definition of concrete, necessity of supervision for concreting operation, different grades of concrete (ordinary concrete, standard concrete &amp; high strength concrete as per provisions of IS 456- 2000), minimum grade of concrete for different exposure conditions, minimum grade of concrete for R.C.C., water retaining structure &amp; in sea water construction, durability of concrete.</p> <p>3.2 Water cement ratio Definition of w/c ratio, Duff Abraham w/c law, significance of w/c ratio, selection of w/c ratio for different grades of concrete prepared from different grades of OPC as per graphs specified in IS 10262 - 1982, maximum w/c ratio for different grades of concrete for different exposure conditions.</p> <p>3.3 Properties of fresh concrete Definition of workability, factors affecting workability of concrete. Determination of workability of concrete by slump cone test, compaction factor test, vee bee consistometer &amp; flow table tests. Range values of workability requirement for different types of concrete works, cohesiveness, segregation, harshness, bleeding.</p> <p>3.4 Properties of hardened concrete Definition of compressive strength, durability, impermeability, elastic properties of concrete, modulus of elasticity of concrete. Creep, factors affecting creep, shrinkage, factors affecting shrinkage</p> <p>3.5 Concrete mix design Objectives of mix design, list of different method of mix design ,study of mix design procedure by I.S. method as per I.S. 10262-1982 ,determination of design mix proportion by mass for M 20 grade of concrete using I.S. Method for given data ( such as grading zone of sand, proportion of 20 mm &amp; 10 mm metals, specific gravities of cement, sand &amp; aggregate , water absorption of sand &amp; aggregate, compacting factor and exposure condition).</p> <p>3.6 Testing of concrete Significance of testing, determination of compressive strength of concrete cubes at different ages, interpretation &amp; co-relation of test results</p> <p>3.7 Non- destructive testing of concrete Importance of NDT, methods of NDT - rebound hammer test &amp; ultrasonic pulse velocity test, working principle of rebound hammer and factor affecting the rebound index, specification for deciding the quality of</p>	16	16
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04	<p>concrete by ultrasonic pulse velocity as per I.S. 13311 ( part 1 &amp; 2 ).  Determination of rebound index &amp; compressive strength of concrete by rebound hammer test as per I.S. 13311, determination of quality of concrete by ultrasonic pulse velocity test</p> <p><b>Quality Control of Concrete:</b></p> <p>4.1 Batching, Different Types of Mixers &amp; Vibrators  Volume &amp; weight batching, volume batching for nominal mixes &amp; weight batching for design mix concrete, types of mixers ( tilting &amp; non-tilting type)  Different types of vibrators - needle vibrator, surface vibrator, table vibrator, principle &amp; application of each type of vibrator</p> <p>4.2 Formwork : formwork for concreting, different types of formworks for different works such as beams, slabs, columns, well foundation, materials used for formwork, requirement of good formwork, stripping time for the removal of formwork as per I.S. 456-2000 provisions for different structural members.</p> <p>4.3 Transportation, placing, compaction &amp; finishing of concrete: Modes of transportation of concrete , precautions to be taken during transportation and placing of concrete in formwork compaction of concrete, methods of compaction, care to be taken during compaction, purpose of finishing, types of finishing &amp; methods of application ( surface treatment, expose aggregate finish, applied finish, coloured finish), requirement of good finish.</p> <p>4.4 Curing of concrete : definition of curing, necessity of curing, different methods of curing and their application ( spraying water, membrane curing, steam curing, curing by infra red radiations, curing by wet gunny bags, ponding methods).</p> <p>4.5 Waterproofing of concrete &amp; joints in concrete construction: Importance &amp; need of waterproofing, methods of waterproofing &amp; materials used for waterproofing, types of joints, joining old &amp; new concrete, methods of joining, materials used for filling joints.</p>	16	20
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05	<p><b>Extreme weather concreting &amp; chemical Admixture in concrete :</b></p> <p>5.1 Extreme weather concreting Effect of cold weather on concrete, effect of hot weather on concrete, precautions to be taken while concreting in hot &amp; cold weather condition.</p> <p>5.2 Chemical admixture in concrete Properties &amp; application for different types of admixture such as accelerating admixtures, retarding admixtures, water reducing admixture, air entraining admixture &amp; super plasticizers.</p>	06	08
06	<p><b>Properties of Special Concrete:</b> Properties, Advantages &amp; Limitation of the following types of Special concrete</p> <p>i) Ready mix Concrete ii) Reinforced Concrete iii) Prestressed Concrete iv) Fiber Reinforced Concrete v) Precast Concrete vi) High performance Concrete</p>	06	08
<b>Total</b>		64	80

**Practical:**

Skill to be developed:

Intellectual Skills:

1. Analyze the given data
2. Select proper method for analysis
3. Interpret the results

Motor Skills :

1. Measure the quantities accurately
2. Handle instruments properly

Term work shall consist of eight experiments in part A & mini project work in Part B

**Part A:** PART A consists of GROUP I & GROUP II.

**Group I**– Physical tests on ordinary Portland cement (any four)

- 1) Determination of fineness of cement preferably by Blaine's air permeability apparatus or by sieving.
- 2) Determination of standard consistency of OPC
- 3) Determination of initial & final setting times of OPC.

- 4) Determination of compressive strength of ordinary portland cement
- 5) Determination of soundness of OPC.

**Group II – Tests on fine & coarse aggregates (any four)**

- 1) Determination of silt content in sand by volume / weight
- 2) Determination of maximum % of bulking of sand
- 3) Determination of aggregate impact value.
- 4) Determination of aggregate abrasion value.
- 5) Determination of aggregate crushing value.
- 6) Determination of bulk density & water absorption, fine & coarse aggregated.

**Part B:**

**Mini Project :**

Comparative study of compressive strength of concrete for different Water cement ratio With and without curing.

**Note:** video cassettes or cd's of above experiments developed by NITTTTR (if available) shall be shown to the students on T. V. / L.C.D. projector prior to the conductance of above experiments.

**Learning Resources:**

**Books:**

Sr.No.	Title	Author	Publisher
1	Concrete Technology	M. L. Gambhir	Tata Mc Graw . Hill Publishing Co. Ltd. New Delhi
2	Concrete technology	A. M. Neyille & J J Brooks	Pearson Education ( Singapore ) Pyt. Ltd. New Delhi
3	Concrete technology	M. S. Shetty	S. Chand Publication
4	Text book of Concrete technology	P. D. Kulkarni	M. H. Ghosh and Phull publication
5	Chemical Admixtures for concrete	H.R. Rixom	Powells' Books

**Reference I.S. Codes:**

1. I.S.4031- ( Part 1 to Part 6 ) Indian standard method of physical tests for hydraulic cement ,BIS, New Delhi.  
 I.S.4031 ( Part 1 ) - 1996 Part 1 – Determination of fineness by dry sieving.  
 I.S.4031( Part 2 ) -1999 Part 2 – Determination of fineness by air permeability method.  
 I.S.4031( part 3 ) -1988 ( reaffirmed 2000 ) Part 3– Determination of soundness  
 I.S.4031(part 4 ) - 1988 ( reaffirmed 1995 )  
 Part 4 - Determination of consistency of standard cement paste.

- I.S.4031 ( part 5 ) – 1988, ( reaffirmed 2000 ) Part 5 - Determination of initial and final setting times
- I.S : 4031 ( part 6 ) – 1988, ( reaffirmed 2000 ) Part 6 - Determination of compressive strength of hydraulic cement other than masonry cement
2. I.S : 2386 ( part i to part vi ) – 1963 Indian standard methods of test for aggregate for concrete. BIS, New Delhi.
    - Part i - Particle size and shape. ( reaffirmed 1997 )
    - Part ii - Estimation of deleterious materials and organic impurities. ( reaffirmed 2002 )
    - Part iii - Specific gravity, density, voids, absorption & bulking. ( reaffirmed 1997 )
    - Part iv - Mechanical properties ( reaffirmed 1997 )
    - part v - Soundness. ( reaffirmed 1997 )
    - part vi - Measuring mortar making properties of fine aggregate. ( reaffirmed 2002 )
  3. I.S. : 383 – 1970 Indian standard specification for coarse & fine aggregates from natural sources for concrete. B.I.S., New Delhi.
  4. I.S. : 1911 - 1959 ( reaffirmed ) Indian Standard methods of sampling and analysis of concrete), B.I.S., New Delhi.
  5. I.S. : 456 - 2000 Indian standard , plain and reinforced concrete – code of practice. ( fourth revision ), B.I.S., New Delhi.
  6. I.S. : 516 – 1959 Indian standard methods of tests for strength of concrete ( xii reprint December 1987 ), B.I.S., New Delhi.
  7. I.S. : 8112- 1989 Indian standard - 43 grade ordinary portland cement Specification
  8. I.S. : 12269 – 1987 ( reaffirmed 1999 ) Indian standard specification for 53 grade O.P.C..
  9. I.S. : 9103 – 1999 Indian standard –concrete admixtures specification
  10. I.S. : 455- - 1989 ( reaffirmed 1995 ) –Indian standard – Portland slag cement specification
  11. I.S. : 1489 ( part 1) 1991 – Portland – Pozzolana Cement – specification part 1 fly ash based
  12. I.S. : 7861 ( part 1 ) 1975 ( reaffirmed 1997 ) – Indian standard of practice for extreme weather concreting part 1 recommended practice for hot weather concreting
  13. I.S.: 7861 ( part 2 ) – 1981 ( reaffirmed 1997 ) – Indian standard of practice For extreme weather concreting part 2 – recommended practice for cold weather concreting
  13. I.S. : 8041 – 1990 – Indian standard – rapid hardening Portland Cement specification BIS- New Delhi
  14. I.S. : 12330 – 1988 ( reaffirmed 1995 ) – Indian standard specification for sulphate resisting Portland cement
  15. I.S. : 12600 - 1989 ( reaffirmed 1995 ) - Portland cement, low heat Specification
  16. I.S. : 10262 – 1982 Indian standard recommended guidelines for concrete mix Design
  17. Sp 23 handbook on concrete mixes ( based on Indian standards)
  18. I.S. 13311 (part-1 & 2)- 1992 methods of non-destructive testing of concrete. part-1 ultrasonic pulse velocity, part-2 rebound hammer